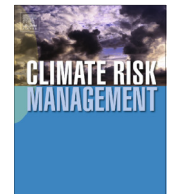


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## Review

# Public perception of climate risk and adaptation in the UK: A review of the literature

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## ABSTRACT

Like other countries, the United Kingdom faces the unavoidable challenge of adapting to a changing climate. However, public perceptions of the risk posed by climate change and support for adaptation policies vary between countries. This article provides a UK-specific review of climate change beliefs, risk perceptions regarding potential climate change impacts, and attitudes towards climate change adaptation. We report on differences between expert and public conceptualisations of climate change risks. We also examine the effects of psychological distancing, climate change awareness, and hazard experience on both concerns about climate change and perceptions of the weather-related risks posed by climate change. Additionally, we review the effects of emotion, agency, perceived responsibility, place attachment, personal values and uncertainty on the willingness of UK residents to support and engage with climate change adaptation. We outline the implications of these factors for climate risk communication and highlight key areas for future research.

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## Introduction

Across the world, decision-makers face the challenge of adapting to a changing climate (Moss et al., 2013). However, public perceptions of the risk posed by climate change and support for adaptation policies vary between countries. Our review focuses on public perceptions of climate change risk and adaptation in the United Kingdom because of the advanced and pioneering nature of climate adaptation research and policy in this country (Mullan et al., 2013). The UK was the first country in the world to adopt climate change legislation that covered both adaptation and mitigation (Climate Change Act 2008). This legislation has required the UK government to assess the risks associated with climate change, and to prepare a national programme for climate change adaptation. The first Climate Change Risk Assessment (CCRA) was published in January 2012 (Defra, 2012), followed by a National Adaptation Programme announced in July 2013.

Climate change adaptation policies will vary by country because of different national contexts and different exposure to climate hazards. These may include changes in the frequency and severity of extreme weather events, sea level rise, changes to the biosphere, and the emergence of hazards that have not before been experienced locally (e.g. forest fires in areas where these have not previously posed a threat, diseases that have previously only thrived in warmer climates becoming more prevalent). Additionally, second order impacts such as supply chain disruption resulting from changes in climate occurring in other parts of the world may pose additional, more complex country-specific risks.

As risk perception has itself been found to be specific to culture and place (Weber and Hsee, 1999), it is also to be expected that public perceptions of the threat posed by climate change, and support for adaptation policies, will vary across countries. Indeed, research making cross-country comparisons has demonstrated clear differences in public climate change beliefs and conceptualisation. Despite the pioneering nature of climate policy in the UK, international comparisons of public climate change beliefs indicate that UK residents are less worried about climate change (Lorenzoni and Pidgeon, 2006), and less likely to believe that climate change is the result of human activity than those in some other European countries such as Italy, Spain and France (Ipsos MORI, 2014). Differences in conceptualisations of climate change have also been found between the UK and the US, with UK residents being more likely to reference 'rain' when asked to describe climate change, and US residents more likely to mention 'heat' and 'ice caps melting' (Lorenzoni et al., 2006); In another UK study that asked people to describe the impacts of climate change, "flooding" was the most common response and "heat" was only the ninth most common response (Whitmarsh, 2009). Indeed, recent research indicates that people in the UK perceive heavy rainfall and flooding to have increased over the course of their lifetime, and hot weather to have decreased over the course of their lifetime, with the former being most strongly associated with their concerns about climate change (Taylor et al., 2014). Even within the UK, public responses to climate change adaptation policies may vary according to perceptions of local climate change risks. For example, residents of the Northern UK may favour the prospect of hotter summers and warmer winters than those in the South East (Palutikof et al., 2004). This further illustrates the importance of understanding regional differences in perceptions of climate change and its potential impacts.

To improve public debate and communication about climate change adaptation, it is important to understand how public perceptions of climate change risk differ from the risk conceptualisations of experts engaged in scientific thinking (Weber and Stern, 2011). Classic public perception research shows that experts and lay people often disagree about how to define risks (Fischhoff et al., 1978; Slovic, 1987; Slovic et al., 1979). Expert assessments of risk are grounded in technical projections of expected death, injury and property damage. By contrast, public risk perceptions tend to consider hazards more risky when they are relatively more unfamiliar, and evoke more negative emotions due to their catastrophic potential (Slovic, 1987). As a result, lay people perceive technologies like nuclear power as more risky than do experts.

More recent work in psychology has also pointed to the importance of emotions, in addition to cognition, in public perceptions of risk and associated decision making (Epstein, 1994; Kahneman, 2011; Kahneman and Frederick, 2002; Loewenstein et al., 2001; Slovic et al., 2005; Stanovich and West, 2000, 2008). Dual-process theories have identified two modes of thought, the intuitive and the analytic (Epstein, 1994; Sloman, 1996; Stanovich and West, 2000, 2008). The intuitive mode of thought is characterised as being fast, undemanding, and driven by emotional responses and spontaneous associations. It tends to be used in everyday thinking, and when expertise or time is limited. The analytic mode meanwhile is characterised as being slow, effortful, and involving deliberate reasoning. It is presumed to be indicative of the formal thought processes required for scientific thinking (Kahneman and Frederick, 2002; Stanovich and West, 2008). The degree to which individuals rely on the two modes of thought may depend on the task at hand. Indeed, scientists may rely more on affective/experiential processes when considering topics on which they are not experts.

This paper reviews the relevant public perception literature on climate change risk and adaptation for the UK, which includes a broad range of fields including psychology, risk management, human geography and social policy. Our review therefore takes a similarly interdisciplinary approach. The following section 'Literature search method' details the literature search

method used to identify those papers directly relevant to UK public perceptions of climate change risk and adaptation. This is followed by eight sections exploring the key themes emerging from these papers. 'Non-experts' mental models of climate change, climate impacts and climate' focuses on lay people's mental models of climate change, including common misconceptions and the role of psychological distance. 'Climate change beliefs and adaptation' discusses the relationship between climate change awareness and willingness to adapt. 'Experience, risk perception and action' focuses on the relationship between hazard experience, risk perception and willingness to engage in adaptation actions. 'Emotions' discusses the potential influence of emotions on perceptions of climate change risk and adaptation. Section 'Responsibility and agency' focuses on the role of perceived responsibility and ability in adapting to climate change impacts. 'Place attachment' covers the potential influences of place attachment and identity on what is considered 'acceptable' adaptation. 'Personal values and individual differences' discusses the role of personal and political values. The challenge of communicating uncertainty about climate change impacts is then considered in 'Uncertainty', with 'Synthesis and future directions' concluding by outlining directions for further research.

## Literature search method

This review focuses on a core set of 44 peer reviewed papers directly relevant to public perceptions of climate change risk and adaptation in the United Kingdom. Where appropriate however discussion of these papers is supplemented by findings from the broader risk perception literature, which includes some studies from outside the UK. To identify this core set of articles a systematic literature search was conducted. Combinations of relevant keywords pertaining to climate change (e.g. climate\* risk, flood\*, weather extreme) and risk (e.g. risk perception\*, risk communication) were initially used to search the Web of Science database (now Web of Science Core Collection) in October 2012 (see [Appendix A](#)). Papers were retained for inclusion in this core set if they: (1) directly pertained to public perceptions of climate change or adaptation to potential climate change impacts; and (2) reported on studies conducted with members of the UK public. Worldwide and pan-European studies were also retained if members of the UK public were included in the sample. Studies that did not focus primarily on perceptions of climate change or adaptation, or that focussed on groups other than the UK public were not included in this core set of articles. Review articles and perspectives were also excluded unless they contained reanalysis of existing data were also excluded from the core set; although some of these are cited here in a supplementary capacity.

Our initial search yielded 27 relevant papers (see supplementary material for a complete list of all 331 papers generated by this search<sup>1</sup>). Additionally, we found that these papers mentioned 17 further relevant references, which were subsequently incorporated into our core set of 44 papers.

As seen in [Table 1](#) below, 2 of the 44 papers identified included UK residents as part of a European sample, and 3 as part of a worldwide sample. Of those papers that explicitly specified that the research was conducted with participants from a particular region of the UK, 15 focussed on England, 5 on England and Wales, 3 on Scotland, and 2 on England and Scotland. Surveys were the most commonly utilised research design (29 papers), followed by interviews (13 papers), focus groups (9 papers), experiments (4 papers) and Q sorting (3 papers). A case study and a participatory workshop were also reported. Sample sizes ranged from  $n = 15$  to  $n > 3000$  depended on the methodology; with surveys using larger samples than interview and focus group studies. The following sections are based on a systematic analysis of these papers.

## Non-experts' mental models of climate change, climate impacts and climate risks

To communicate effectively about climate change and climate change adaptation, it is important to understand people's current beliefs, as well as potential misunderstandings ([Bruine de Bruin and Bostrom, 2013](#); [Morgan et al., 2001](#)). In this section we discuss existing research about how the UK public conceptualise climate change, its potential impacts and the threats posed by those impacts. We focus on two key findings: the conflation of climate change and the risk posed by its impacts with other environmental risks, and psychological distance.

### *The conflation of climate change with other environmental risks*

One finding that has been consistently observed in the UK and elsewhere is that climate change and its associated risks are often conflated with other environmental problems ([Bostrom and Lashof, 2007](#); [Kempton, 1991](#); [Read et al., 1994](#); [Reynolds et al., 2010](#)). When asked to describe climate change, a large proportion of UK and US participants have made reference to ozone depletion ([Lorenzoni et al., 2006](#); [Whitmarsh, 2009](#)). Indeed, cross-European research indicates that people often fail to distinguish between environmental issues; emphasising general concerns pertaining to resource use, regardless of the specific issue in question ([Fischer et al., 2012](#)). These observations are consistent with the notion (outlined in the 'Introduction') that non-experts' everyday thinking draws upon spontaneous associations ([Kahneman, 2011](#); [Kahneman and Frederick, 2002](#); [Stanovich and West, 2008](#)). It is also in keeping with research in the broader risk communication literature which suggests that people draw on analogies with familiar risks when trying to understand less familiar risks ([Palmgren et al., 2004](#); [Visschers et al., 2007](#); [Wallquist et al., 2010](#)). Of course, the conflation of climate change with other environmental problems does not necessarily preclude people from making appropriate behavioural changes or supporting

<sup>1</sup> This reference list represents an accurate reflection of search output for the period January 1900–October 2012 as of 01/09/2014.

**Table 1**

Papers identified in the literature search including geographic focus, methodology and sample size.

Authors	Title	Geographic focus	Method	Sample size
Abrahamson et al. (2009)	Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK	London Norwich (Norfolk)	Interview	(n = 73)
Bellamy and Hulme (2011)*	Beyond the Tipping Point: Understanding Perceptions of Abrupt Climate Change and Their Implications	East Anglia	Mixed	Survey (n = 287) Focus group (n = 15)
Bichard and Kazmierczak (2012)*	Are homeowners willing to adapt to and mitigate the effects of climate change?	England and Wales	Survey	(n = 961)
Bradford et al. (2012)*	Risk perception – issues for flood management in Europe	Europe	Survey	(n = 1375)
Burningham et al. (2008)	'It'll never happen to me': understanding public awareness of local flood risk	England and Wales	Mixed	Survey (n > 1000) Focus groups (undisclosed) Interview (undisclosed)
Butler and Pidgeon (2011)*	From 'flood defence' to 'flood risk management': exploring governance, responsibility, and blame	Sheffield, Oxford, Gloucester	Interview Focus group	Interview (n = 45) Focus group (n = 50)
Clements (2012)*	Exploring public opinion on the issue of climate change in Britain	UK	Survey	Survey 1 (n = 1000) Survey 2 (n = 2850) Survey 3 (n = 3393)
Corner et al. (2011)*	Nuclear power, climate change and energy security: Exploring British public attitudes	UK	Survey	n = 1822
Costa-Font et al. (2009)*	Optimism and the perceptions of new risks	UK	Survey	(n = 1547)
Dessai and Sims (2010)	Public perception of drought and climate change in southeast England	South-East England	Mixed	Survey (n = 102) Focus group (n = 14)
Few et al. (2007)	Public participation and climate change adaptation: Avoiding the illusion of inclusion	Christchurch Bay (Dorset), Orkney	Interview Participatory workshop	Undisclosed
Fielding (2012)	Inequalities in exposure and awareness of flood risk in England and Wales	England and Wales	Survey	(n = 1034)
Fischer et al. (2012)*	Climate Change? No, Wise Resource Use is the Issue: Social Representations of Energy, Climate Change and the Future	Europe	Interview	(n = 202)
Glenk and Fischer (2010)	Insurance, prevention or just wait and see? Public preferences for water management strategies in the context of climate change	Scotland	Survey	(n = 1033)
Harries (2012)*	The anticipated emotional consequences of adaptive behaviour-impacts on the take-up of household flood-protection measures	England	Survey	(n = 555)
Harries (2008)	Feeling secure or being secure? Why it can seem better not to protect yourself against a natural hazard	UK	Focus group Interview	(n = 40)
Harris and Corner (2011)*	Communicating Environmental Risks: Clarifying the Severity Effect in Interpretations of Verbal Probability Expressions. Journal of Experimental Psychology-Learning Memory and Cognition	England and Wales	Experiment	Experiment 1 (n = 101) Experiment 2 (n = 83) Experiment 3 (n = 191)
Harvatt et al. (2011)	Understanding householder responses to natural hazards: flooding and sea-level rise comparisons	Truro (Cornwall) Aldeburg (Suffolk) Barnstaple (Devon)	Mixed	Survey (n = 77) Interview (n = 35)
Howell (2011)*	Lights, camera ... action? Altered attitudes and behaviour in response to the climate change film The Age of Stupid	Edinburgh	Survey	Survey 1 (n = 213) Survey 2 (n = 162)
Howgate and Kenyon (2009)*	Community cooperation with natural flood management: a case study in the Scottish Borders	Borthwick (Scottish Borders)	Case study (including survey)	Survey (n = 30)
Lamond et al. (2009)*	Accessibility of flood risk insurance in the UK: confusion, competition and complacency	UK	Survey	(n = 403)
Lorenzoni et al. (2006)*	Cross-national comparisons of image associations with "global warming" and "climate change" among laypeople in the United States of America and Great Britain	UK and US	Survey	UK (n = 316) US (n = 673)

Lorenzoni et al. (2007)*	Barriers perceived to engaging with climate change among the UK public and their policy implications	UK	Mixed	Study 1 (see Whitmarsh, 2008) Study 2 (see O'Neill and Nicholson-Cole, 2009) Study 3 Survey (n = 200) Study 3 Focus group (undisclosed)
Lorenzoni and Pidgeon (2006)*	Public views on climate change: European and USA perspectives	Europe and US	Survey	Reanalysis of multiple surveys
Lowe et al. (2006)	Does tomorrow ever come? Disaster narrative and public perceptions of climate change	Norwich (Norfolk)	Mixed	Survey (n = 301) Focus group (undisclosed)
Morton et al. (2011)	The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications	UK	Experiment	Study 1 (n = 88) Study 2 (n = 120)
Niemeyer et al. (2005)	Rapid climate change and society: Assessing responses and thresholds	West Midlands	Interview Q sorting	(n = 29)
O'Neill and Nicholson-Cole (2009)	"Fear Won't Do It" Promoting Positive Engagement With Climate Change Through Visual and Iconic Representations	UK	Mixed	Interview/Q sort (n = 30) Focus group (n = 27) Survey (n = 63)
Palutikof et al. (2004)	Public perceptions of unusually warm weather in the UK: impacts, responses and adaptations	Scotland, South of England	Survey	(n = 295)
Parker et al. (2007)*	Enhancing the human benefits of flood warnings. Natural Hazards	England and Wales	Mixed	Reanalysis of multiple surveys and interviews
Parker et al. (2011)*	Surface water flood warnings requirements and potential in England and Wales	Wealdstone Brook (Greater London) and Rotherham (Yorkshire)	Focus groups	Public focus groups (n = 31) Emergency responder focus groups (n = 33)
Pidgeon et al. (2008)*	Climate change or nuclear power – No thanks!	UK	Survey	Reanalysis of multiple surveys (n = 1822)
Poortinga et al. (2011)	Uncertain climate: An investigation into public scepticism about anthropogenic climate change	UK	Survey	
Rabinovich and Morton (2012)*	Unquestioned answers or unanswered questions: beliefs about science guide responses to uncertainty in climate change risk communication	UK and Worldwide	Experiment	Study 1 (n = 108) Study 2 (n = 106)
Rundblad et al. (2010)*	Communication, perception and behaviour during a natural disaster involving a 'Do Not Drink' and a subsequent 'Boil Water' notice: a postal questionnaire study	Gloucestershire	Survey	(n = 195)
Soane et al. (2010)	Flood perception and mitigation: the role of severity, agency, and experience in the purchase of flood protection, and the communication of flood information	UK	Survey	(n = 1732)
Spence and Pidgeon (2010)	Framing and communicating climate change: The effects of distance and outcome frame manipulations	UK	Experiment	(n = 161)
Spence et al. (2012)*	The Psychological Distance of Climate Change	UK	Survey	(n = 1822)
Spence et al. (2011)*	Perceptions of climate change and willingness to save energy related to flood experience	UK	Survey	(n = 1822)
Whitmarsh (2011)*	Scepticism and uncertainty about climate change: Dimensions, determinants and change over time	Hamshire, Norfolk	Survey	(n = 1140)
Whitmarsh (2008)*	Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response	South of England	Mixed	Survey (n = 589) Interview (n = 24)
Whitmarsh (2009)	What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming"	South of England	Survey	(n = 589)
Wolf et al. (2010a)*	Heat waves and cold spells: an analysis of policy response and perceptions of vulnerable populations in the UK	Norwich (Norfolk)	Interview	(n = 15)
Wolf et al. (2010b)*	Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities	London and Norwich (Norfolk)	Interview	(n = 105)

\* Denotes papers extracted from Web of Science (now Web of Science Core Collection) using the search terms outlined in [Appendix A](#).

policies to mitigate or adapt to climate change. However, as [Weber and Stern \(2011\)](#) have noted, it may inadvertently lead people to believe that the effects of climate change could dissipate as quickly as the effects of other forms of pollution, thus reducing the perceived need for longer term adaptation measures.

While less widely investigated in a UK context, the conflation of the risks posed by climate change impacts with different (if related) hazards may also be a barrier to adaptation. For instance, an increase in the severity and frequency of summer heat waves and development of urban hotspots are amongst the projected climate change impacts for the UK ([Defra, 2012](#)). While this poses potentially serious health dangers to groups such as the elderly, interviews with British older adults found that some confused the dangers posed by heat waves with those of UV exposure ([Wolf et al., 2010b](#)). Such misunderstandings may lead to the implementation of inappropriate risk protection efforts, such as applying sunscreen to prevent sunburn but not drinking enough water to prevent dehydration. The capacity for such misunderstanding to lead to possible harm has also been highlighted in UK research examining public responses to “Do Not Drink” warnings, issued after flooding in the Gloucestershire area led to disruption in the supply of clean drinking water. Here it was found that non-compliance with warnings was linked to an erroneous belief that boiling water would provide sufficient protection against all forms of contamination ([Rundblad et al., 2010](#)). Potential conflation may be even more likely with respect to less familiar climate change impacts. For example, interviews with residents in areas of Southern England at risk from future sea level rise found that they tended to draw parallels with the more familiar hazards of flooding and coastal erosion ([Harvatt et al., 2011](#)).

### *Optimism bias and psychological distance*

Of course, in order to take appropriate adaptive measures with respect to present and future hazards, one must recognise that one is at risk. However, as UK flood risk perception research demonstrates not all those who could be classified as ‘at risk’ are aware of the threat to their local area ([Burningham et al., 2008](#); [Fielding, 2012](#)). Similarly, people may be aware of the risk, but not perceive themselves to be personally vulnerable. This may be due to individuals not identifying themselves as being part of an ‘at risk’ group; as was found when older adults in South East England were interviewed about heat wave protection ([Abrahamson et al., 2009](#); [Wolf et al., 2010a,b](#)). It may also result from optimism bias, or the perception that one’s probability of experiencing negative events is low ([Weinstein, 1987](#)). With respect to the latter, optimism bias has been found to be associated with greater climate change risk acceptance amongst UK residents ([Costa-Font et al., 2009](#)).

Similar to optimism bias, another aspect of non-experts mental models of climate change that has been found to impact on climate change risk perception is that of psychological distance. In this context psychological distance is defined as the extent to which the impacts of climate change are perceived as affecting distant geographical areas, occurring further into the future, and harming other social groups ([Locke and Latham, 1990](#)). All three forms of psychological distance have been associated with lower concern about climate change and greater uncertainty about its existence amongst UK residents ([Spence et al., 2012](#)). While UK participants may generate dramatic and disastrous imagery when thinking of climate change, they tend to associated it with other areas of the world, thus increasing psychological distance ([Lorenzoni et al., 2006](#)). In the broader literature, the finding that people tend to consider local environmental problems less serious than those occurring at a larger geographic scale has been documented in a number of contexts ([Uzzell, 2000](#)). Similarly, risks that are expected to occur in the future are considered to be much less important than risks that are more immediate ([Hardisty and Weber, 2009](#); [Myerson and Green, 1995](#)). However, direct experience with risks may make them seem more concrete and less psychologically distant ([Trope and Liberman, 2010](#)). Research comparing the climate change beliefs of those in the UK and Australia suggests that this may be the case; with UK residents demonstrating greater psychological distance than those in Australia, who have had greater exposure to severe climate impacts ([Reser et al., 2012](#)).

In addition to potentially reducing concern about climate change and willingness to engage in mitigation activities, optimism bias and psychological distance may also affect willingness to engage in proactive adaptation to future climate change impacts. Indeed, in case studies examining two UK coastal communities at risk from sea level rise it was found that while residents agreed that ‘something should be done,’ they were unwilling to act due to uncertainty about how imminent the threat would be ([Few et al., 2007](#)). However, further research is needed to examine under which conditions psychological distancing might act as a barrier to adaptation, and whether it varies with nature and familiarity of the impact in question.

### **Climate change beliefs and adaptation**

Longitudinal analysis of public opinion polls indicate that consensus amongst experts as to the existence of anthropogenic climate change is overwhelmingly high ([Doran and Zimmerman, 2009](#)). By comparison, belief in the existence of manmade climate change amongst non-experts in the UK and elsewhere is prone to greater vacillation ([Ratter et al., 2012](#)). Yet, few UK studies have examined the relationship between climate change awareness and willingness to implement adaptation. A recent survey conducted in England and Wales found a significant correlation between climate change awareness and stated willingness to adopt domestic level flood protection ([Bichard and Kazmierczak, 2012](#)). However, no relationship between climate change awareness and willingness to engage in water saving behaviours was found amongst participants in UK areas at risk of drought ([Dessai and Sims, 2010](#)).

Findings from other developed countries also show a somewhat mixed picture. A survey with householders in Dresden found only a weak association between climate change awareness and willingness to undertake action in response to the



threat of flooding, with household size, prior flood experience, and home ownership having stronger associations with flood protection uptake (Kreibich, 2011). Interviews and surveys with landholders in South West Australia found little difference between climate change believers and sceptics with respect to their tendency to focus on short-term rather than long-term actions in responding to the threat posed by hotter, drier conditions (Mazur et al., 2013). In line with these findings, two other Australian studies showed that support for proactive adaptation initiatives may be lower amongst climate sceptics (Alexander et al., 2012; Buys et al., 2012). In the latter case, individuals who did not believe that sea level rise is occurring tended to be strongly opposed to preventive retreat from coastal areas.

A recent US survey reported support for preventative adaptive action to limit the damage caused by future storms and sea level rise (Stanford Woods Institute for the Environment, 2013). Interestingly, 60% of respondents who doubted the existence of climate change still supported some form of adaptation, perhaps because of the salience of Hurricane Sandy (Stanford Woods Institute for the Environment, 2013). It is therefore possible that where projected climate change impacts are more familiar, more immediate and more salient, climate change beliefs have low impact on willingness to proactively adopt protection measures and support adaptation policy. In a UK context, this may mean that willingness to support proactive adaptation measures against increased flood risk may be strong independent of climate change beliefs, while climate change beliefs do play a role in willingness to protect against less familiar impacts. However, more UK focussed research is needed to ascertain whether this is indeed the case.

### Experience, risk perception and action

As discussed in 'Non-experts' mental models of climate change, climate impacts and climate' and 'Climate change beliefs and adaptation', research suggests that familiarity with extreme weather events can reduce psychological distancing (Reser et al., 2012), and increase support for adaptation policy (Stanford Woods Institute for the Environment, 2013). It also suggests that people draw on intuitive associations and analogy with familiar hazards in forming mental models of those that are less familiar (Fischer et al., 2012; Visschers et al., 2007; Wallquist et al., 2010). However, when considering the relationship between direct personal experience of hazards and the perceived threat posed by them, a mixed pattern of results emerges.

Work in the broader risk perception literature suggests that when making judgments and choices from experience, people can overestimate the likelihood of hazards that have recently been experienced (Hertwig et al., 2004), especially when these events are rare but extreme in nature (Keller et al., 2006). Paradoxically however, where they have not been recently experienced, the likelihood of severe but rare hazards may also be underestimated as a result of their infrequency (Hertwig and Erev, 2009). This can be explained by what is known as the *availability heuristic*, whereby experiencing a highly negative event increases its availability from memory, which in turn increases the perceived likelihood of its re-occurrence (Kahneman et al., 1982). However, in cases where people have been exposed to a hazard without experiencing expected negative outcomes, they may subsequently perceive it to be less risky (Halpern-Felsher et al., 2001). Hence, familiar hazards may evoke less fear than those that are less familiar if they have not led to personal experiences with negative outcomes (Slovic, 1987).

As previously noted, in the UK it is anticipated that climate change will increase the frequency and severity of relatively familiar extreme weather events such as flooding, heat waves and drought. It is therefore important to understand how this prior experience can affect both risk perception and the adoption of climate change adaptation.

#### *Experience and adaptation to climate change impacts*

The UK is likely to experience more flooding as a result of climate change in the future (Defra, 2012). Previous work indicates a strong association between flood experience and flood risk awareness (Burningham et al., 2008). A survey across 13 European locations including Scotland found that flood experience was associated with both flood awareness and flood preparedness, but not with climate change awareness (Bradford et al., 2012). However, responses to open ended questions also suggested that risk perception amongst those who had previously experienced flooding can diminish as a consequence of new flood defences being erected (Bradford et al., 2012). Other UK studies have found that individuals who had flood experience were more likely to have taken steps to install home flood protection – though uptake of most measures was still relatively low (Harries, 2012; Lamond et al., 2009). Another investigation observed that UK participants who reported direct flood experience and perceived more risk severity were more likely to have adopted some form of protection (Soane et al., 2010). However, as discussed in the following section on 'Emotions', there are also situations in which flood experience may actually reduce the uptake of flood protection by increasing anxiety and avoidant behaviour (Harries, 2012).

Relatively few UK studies have examined the extent to which prior experience with weather-related events other than flooding influences uptake of protective measures. One UK survey did find that respondents who recalled discomfort during a heat wave tended to perceive more negative impacts of that heat wave on health service provision, agriculture, and work productivity (Palutikof et al., 2004). It would thus seem possible that past experience of discomfort may also influence perception of future events and willingness to adopt adaptive measures. Another study found that people in Southern and Anglian regions of England enacted water saving measures in response to water-shortages during a regional drought,

without persisting in doing so afterwards (Dessai and Sims, 2010). Hence, experience with certain hazards may not always translate into long-term behavioural change.

### *Experience of extreme weather and beliefs about climate change*

Studies conducted in the UK and elsewhere have shown that perceived (Li et al., 2011; Taylor et al., 2014) and experienced (Deryugina, 2013; Egan and Mullin, 2012) changes in local weather are associated with stronger climate change beliefs. However, the extent to which the experience of particular extreme weather events impact on belief in the existence of climate change, and concern about its impacts, is less well-known.

With respect to flooding, one UK study found that individuals with personal flood experience were no more likely than others to believe in anthropogenic climate change, perceive climate change as personally threatening, or implement mitigation behaviours (Whitmarsh, 2008). However, a more recent UK survey did find a positive association between reported flood experience and willingness to reduce energy consumption, which may have been due to increased climate change concern, perceived self-efficacy, and perceived climate change risk to local area (Spence et al., 2011). This disparity in findings could be explained in a number of ways. The authors of the latter study note that recent flooding in the UK, along with recent public discourse about climate change, may have rendered the link between climate change and flooding more salient amongst those with flood experience (Spence et al., 2011). Differences in sampling and the definition of 'flood experience' may also have contributed to the difference in findings between the two studies: The former surveyed respondents from a specific region of England (Hampshire) and defined 'flood experience' as having property damaged by flooding (Whitmarsh, 2008). The second survey utilised a representative nationwide sample and defined 'flood experience' as encountering flooding in one's local area (Spence et al., 2011).

In work outside the UK it has been posited that experience of extreme weather and natural disasters increases concern about climate change and willingness to engage in mitigation activities – but only if the experienced event itself is attributed to climate change (Reser et al., 2014; Reser et al., 2012). The findings of one longitudinal US study have also suggested that experience of extreme weather events may increase climate change concern amongst those without strong pre-existing climate change beliefs, but that those possessing strong belief or strong disbelief in the existence of climate change may engage in motivated reasoning and interpret events in a manner that supports existing beliefs (Myers et al., 2013). While climate change is a politically polarising issue in the UK (Spence et al., 2011; Whitmarsh, 2009), there is greater agreement that climate change is caused by human activity amongst the general population in the UK (64%) than in the US (54%) (Ipsos MORI, 2014). Hence, one might expect to find a stronger association between experience of extreme weather events and climate change concern amongst UK residents. However, based on the evidence currently available, firm conclusions cannot be drawn. Longitudinal research would be needed to establish the extent to which directly experiencing extreme events influences climate change beliefs and concern.

Based on the research discussed above it appears that the extent to which prior experience of extreme weather and associated hazards impact on both preparedness to adapt, and beliefs about climate change, warrants further exploration. With regard to adaptation in particular, it would seem that the relationship between prior experience and willingness to engage in proactive adaptation may depend on the nature of the hazard. However, as the available literature has primarily focussed on flooding, more research is needed regarding the extent to which prior experience of heat waves, water restrictions during droughts, and other anticipated climate change impacts. Another question that may be asked is whether preparedness to adopt and support protective measures in response to one type of extreme weather event generalises to other anticipated climate change impacts; and, if so, whether this is contingent on concern about climate change.

### **Emotions**

As noted in the 'Introduction', emotions have long been recognised as playing a key role in public risk perception. Hazards that evoke negative emotions tend to be perceived as more risky and requiring mitigation (Slovic, 1987). However, intense negative emotions can have a counterproductive effect on risk protection behaviour, with fear and anxiety leading to avoidant behaviours and defensive denial (Witte and Allen, 2000).

In the UK, research examining the efficacy of using anxiety-provoking communications and scenarios to increase climate change awareness has produced mixed results. Viewing the climate change disaster film *The Day After Tomorrow* has been associated with both greater anxiety regarding climate change and a desire to "do more" to mitigate climate change, but also with greater psychological distancing, perhaps as a strategy for anxiety avoidance (Lowe et al., 2006). This is echoed by findings gathered from focus-groups, suggesting that while alarmist imagery may succeed in inducing climate change concern, it may also reduce perceptions about being able to do "something about climate change" and increase psychological distancing, denial and apathy (O'Neill and Nicholson-Cole, 2009). A later study did find that those viewing climate change disaster movie *The Age of Stupid* reported a subsequent increase in mitigation behaviours (Howell, 2011). However, participants in this study already showed high levels of climate concern prior to viewing the movie (Howell, 2011). Hence, the impact of anxiety-provoking communication on action may be moderated by existing concerns about climate change.

Individual responses to severe hypothetical climate change scenarios may also depend on how much anxiety is evoked. For instance when being presented with extreme climate change scenarios, focus-group participants expressed helplessness



and fatalism (Bellamy and Hulme, 2011; Niemeyer et al., 2005), while less extreme scenarios elicited more adaptive responses (Niemeyer et al., 2005). One experimental study did find stronger levels of fear to be associated with better information recall, which was in turn associated with a more positive attitude towards climate mitigation (Spence and Pidgeon, 2010). However, in this latter investigation the communications presented to participants were not alarmist in nature, and mitigation was presented as a feasible risk reduction measure. This is in keeping with findings from the broader risk communication literature, which suggests that fear-appeals tend to be effective only when they trigger moderate (rather than high) fear, and provide recipients with easy to implement strategies to reduce risk (Witte and Allen, 2000).

With respect to adaptation to climate change impacts, the available evidence also suggests that greater anxiety may not always lead to greater uptake of protective measures. Recent research has suggested that UK flood victims who have high anxiety about flooding may avoid protective behaviour because they don't want to be reminded about their negative experience with flooding (Harries, 2012). These findings were consistent with previous work (Harries, 2008), which found that a desire to preserve feelings of security in the home may, in certain cases, act as a barrier to the adoption of protective measures. Indeed, in a survey conducted with a pan-European sample, greater self-reported worry about flooding was not found to correspond with better flood preparedness (Bradford et al., 2012). It has also been suggested that the low response to flood warnings observed amongst the UK public may be partly attributable to stress induced passivity (Parker et al., 2007). Again, this suggests that using anxiety-provoking communications to highlight domestic flood risk may not always be effective in encouraging the uptake of protective behaviours.

Of course, while flooding is associated with negative emotions, the same cannot necessarily be said for all climate change impacts. Owing to the UK's temperate climate, and the relative infrequency of hot weather, the prospect of more hot summers and warmer winters may evoke positive emotions amongst those living in the UK. Existing research does indeed suggest that this is the case, especially amongst those in cooler regions of the UK (Palutikof et al., 2004). As people tend to perceive things they feel positively towards as less risky (Slovic et al., 2004), this may reduce recognition of the need for protective action in the event of heat waves. More research is however needed to ascertain how UK residents currently perceive the risks posed by heat waves, and whether this impacts on protective behaviours and support for risk reduction policy.

## Responsibility and agency

In exploring the factors influencing public willingness to support climate change adaptation policy, and adopt protective measures at an individual level, it would seem reasonable to question what the roles of responsibility and agency might be. Research focussing on barriers to climate change mitigation amongst members of the UK public found that participants often expressed powerlessness (e.g. the sentiment that individual actions made little difference) and lower responsibility for carbon emissions than other actors (e.g. the government, larger countries such as the US); a finding that posited to result from motivated reasoning to justify a lack of motivation to act, or avoid anxiety (Lorenzoni et al., 2007). However, this does not address whether these factors will be a barrier to adaptation, which focusses on impacts rather than causes.

To date, evidence suggests that people in the UK do tend to perceive central and local government as responsible for implementing climate change adaptation. Survey studies show that flood risk management is seen as a task for the government and regulators, with some responsibility being attributed to home owners for protecting their own property (Bichard and Kazmierczak, 2012; Soane et al., 2010). Interviews with residents of three UK cities affected by flooding also showed that local authorities were held responsible, with residents' personal power to manage floods being perceived as low (Butler and Pidgeon, 2011).

Yet, the relationship between perceived responsibility and the uptake of domestic flood protection measures remains unclear. One investigation found that uptake of flood protection was higher amongst respondents who judged responsibility of regulators to be low (Soane et al., 2010). Another found that attribution of responsibility was not significantly associated with willingness to adopt flood protection (Bichard and Kazmierczak, 2012). Amongst residents of Southern and Anglian regions of England surveyed regarding drought and water restrictions, a majority stated that responsibility for water management lay with private companies or government (Dessai and Sims, 2010). However, a Scottish case study examining local residents' willingness to accept the development of flood defences for the benefit of other communities showed that people may be willing to support protective action if they perceive responsibilities towards the intended beneficiaries (Howgate and Kenyon, 2009). Hence, the extent to which attributions of responsibility are associated with willingness to support adaptation and undertake protective behaviours is unclear. Additionally, as much of the available research focusses on the familiar hazard of flooding, the question of how perceived responsibility might affect response to less familiar climate change impacts is yet to be addressed.

As noted above, interviews with members of the public in an area with high flood risk suggested that participants commonly perceived themselves to be "powerless" with respect to flood risk management (Butler and Pidgeon, 2011). This theme of "powerlessness" was also echoed in interviews with people in areas at risk from water shortages (Dessai and Sims, 2010). Within the risk literature, such lack of agency has been linked with being less likely to take protective action. Indeed, perceived behavioural control is among the key elements of behaviour change theories (e.g. Ajzen and Madden, 1986; Bandura, 1977; Maddux and Rogers, 1983).

In the domain of climate change, agency has been linked to willingness to engage in both mitigation and adaptation amongst UK residents. For instance, the perception that "I can personally help to reduce climate change by changing my behaviour" was found to be a significant predictor of willingness to undertake energy saving measures (Spence et al., 2011). In an examination

of the antecedents of flood protection purchase, agency was also linked to the adoption of protection (Soane et al., 2010). Another recent study however did not find that link (Harries, 2012), perhaps due to self-efficacy predicting the adoption of short-term reactive measures rather than long-term protective actions (see also (Zaalberg et al., 2009)).

Of course, as has been noted with respect to mitigation (Lorenzoni et al., 2007), a reported lack of agency may not always reflect a straightforward appraisal of one's capacity to act. In situations where the decision to act or not act may be construed as having a moral component (e.g. reducing energy use to mitigate against climate change, engaging in water saving behaviour during a water shortage), failure to undertake moral actions may lead to displacement of responsibility or minimisation of agency (Bandura et al., 1996).

## Place attachment

It has been argued that factors such as culture, identity, attachment to place, values and regional risk attitudes will determine both the perceived need to adapt and the acceptability of particular adaptive measures (Adger et al., 2009). Some authors note the importance of examining how lay people's perceptions of climate change are related to their relationship with the landscape (Brace and Geoghegan, 2011; Geoghegan and Leyson, 2012), and the need to consider attachment to place in relation to climate change adaptation (Devine-Wright, 2013). However, we found no UK studies examining the role of place attachment in support for climate change adaptation. Recent work focussing on acceptance of renewable energy developments in Northern Ireland has however suggested that acceptance of developments depends on the extent to which the developments are perceived to fit the symbolic meaning of the specific place; for instance, with support for novel developments when place attachment is less characterised as being 'anti-change' (Devine-Wright, 2011). Similar issues may arise in the context of climate change adaptation developments. Further research is however needed to ascertain whether this is the case.

## Personal values and individual differences

In the literature on public perceptions of climate change a number of studies have focussed on the role of individual differences such as pro-environmental values, cultural worldview, and political affiliation, in shaping beliefs and concern about climate change. However, fewer studies have examined how these factors affect attitudes towards specific climate change impacts and adaptation.

Drawing on work conducted in the field of anthropology, four fundamental "cultural worldviews" have been identified as relevant to risk perception (Douglas and Wildavsky, 1983): Hierarchists value social and institutional hierarchies and view nature as manageable if appropriate regulations are enforced; Egalitarians, while concerned about group welfare, reject institutionally imposed regulation and view nature as fragile and easily disrupted; Individualists emphasise personal freedom and personal responsibility, and view nature as benign; Fatalists tend to view outcomes as the product of chance and nature as fundamentally outside human control. It has been proposed that these four cultural worldviews map onto perceptions of climate change and its solutions (Thompson and Rayner, 1998); with Hierarchists favouring expert-driven regulatory approaches to mitigation, Egalitarians favouring voluntary approaches, Individualists favouring market-based approaches, and Fatalists being disengaged from the matter. In one survey, it was found that, consistent with the views on nature detailed above, egalitarians expressed more concern about climate change than individualists and fatalists (Bellamy and Hulme, 2011). However, in a follow-up focus group, cultural views failed to align with policy preferences, and statements of fatalism were common across participants (Bellamy and Hulme, 2011). Hence, evidence regarding the efficacy of operationalizing cultural theory as a quantitative 'individual difference' measure appears to be mixed.

However, the cultural theory approach described above has been criticised for failing to capture attitudes towards different types of risk (Sjoberg, 2000). Indeed, UK research shows that pro-environmental values specifically are associated with belief in the existence of anthropogenic climate change (Poortinga et al., 2011; Whitmarsh, 2008, 2011), as well as with greater climate change concern, perceived personal threat from climate change, and willingness to engage in mitigation actions (Whitmarsh, 2008). This is similar to findings obtained in other developed countries (Brody et al., 2008; Kellstedt et al., 2008). Also in keeping with findings obtained in other developed countries (McCright and Dunlap, 2011, 2013; Reser et al., 2012; Zia and Todd, 2010), research in the UK has demonstrated a consistent association between right-of-centre political affiliation and greater climate change scepticism (Clements, 2012; Poortinga et al., 2011; Whitmarsh, 2008, 2011); although as previously noted climate scepticism does not appear to be as strong in the UK as the US (Ipsos MORI, 2014; Lorenzoni and Pidgeon, 2006).

Of course, while pro-environmental values and political affiliation are associated with beliefs about the nature and causes of climate change (Poortinga et al., 2011; Whitmarsh, 2008, 2011), their relationship with support for adaptation policy is far less well understood. As noted in the earlier section on 'Climate change beliefs and adaptation', belief in the existence of anthropogenic climate change may not necessarily be a prerequisite for supporting adaptation to the anticipated impacts of climate change (Stanford Woods Institute for the Environment, 2013). Conversely, being concerned about climate change and having strong pro-environmental values does not necessarily mean that one will support all adaptation measures. In the context of mitigation, for instance, it has been demonstrated that climate change concern does not necessarily lead to greater support for nuclear power amongst UK residents (Corner et al., 2011; Pidgeon et al., 2008). Hence, more research is needed to identify the extent to which individual differences affect the types of adaptation UK residents are willing to support and

personally undertake. Our literature search revealed only one UK study examining the relationship between individual values and support for climate change adaptation measures. This study investigated the extent to which support for two flood adaptation measures (soft engineering and public insurance) could be predicted by general versus more context specific personal values (Glenk and Fischer, 2010). It was found that while the context-specific “governance related” values of sustainability and solidarity predicted support for the soft-engineering and public insurance measures respectively; sustainability and solidarity were themselves associated with greater concern for the wider world (Glenk and Fischer, 2010), as measured by the construct of “self-transcendent” (Schwartz, 1992, 1994). These findings are interesting as they suggest that both context-specific and general values can influence support for adaptation policy. However, as this is as yet an isolated study, the extent to which these findings might generalise is yet to be determined. Again, more research is needed to identify how individual differences impact on support for climate change adaptation in different contexts.

## Uncertainty

While there is little disagreement amongst climate scientists as to the existence of anthropogenic climate change (Doran and Zimmerman, 2009), far greater uncertainty exists as to what its precise impacts will be on human and natural systems at regional and local levels (Dessai et al., 2007; Field et al., 2014). The question of how the public perceives and responds to this uncertainty is therefore a matter of some concern in the field of climate risk management; as is the question of how uncertainty in climate and climate impact projections can best be communicated to the public (Dessai and Hulme, 2004; Pidgeon and Fischhoff, 2011; Spence et al., 2012).

A 2007 poll conducted in the UK indicated that 40% of the UK population agreed that “the climate system is too complex and uncertain for scientists to make useful forecasts” (Downing and Ballantyne, 2007). It has also been found that uncertainty regarding how serious the impacts of climate change will be correlates with greater scepticism regarding the existence of climate change and its anthropogenic nature (Spence et al., 2011). When combined with the fact that greater uncertainty regarding the existence and severity of anthropogenic climate change is associated with greater psychological distancing (Spence et al., 2012), this raises the question as to the extent to which uncertainty about the severity and nature of climate change impacts could act as a barrier to adaptation. In the study of psychological distance cited above, climate change uncertainty was not found to be an independent predictor of willingness to undertake mitigation actions (Spence et al., 2012). However, as discussed in the section on ‘Non-experts’ mental models of climate change, climate impacts and climate’, case studies conducted with two British communities at risk from sea level rise suggest that uncertainty about future climate, compounded by temporal distance, can be a barrier to proactive adaptation (Few et al., 2007). Again, the extent to which a particular type of impact has already been experienced may affect the extent to which uncertainty over its future frequency and severity reduces willingness to act. Prior exposure to “false alarms” may also reduce willingness to act; an issue raised in UK flood warning focus groups (Parker et al., 2011).

It is also worth noting that not all findings indicate that uncertainty is an unequivocal barrier to action. The results of a recent series of UK investigations suggests that when uncertainty exists in communications about climate change, pro-environmental behavioural intentions are facilitated by (a) framing information in a manner that elicits caution (Morton et al., 2011) and (b) a belief that the goal of science is debate rather than absolute truth (Rabinovich and Morton, 2012). Whether attitude towards scientific uncertainty and precautionary message framing might impact on willingness to support adaptation policies and actively adopt protection against climate change impacts is however not yet clear.

One problem faced by those seeking to communicate the uncertainties associated with climate change and its impacts with the public, is that this information may not be readily understood by recipients, or interpreted as communicators intend. Ability to appropriately understand and utilise risk information can be strongly influenced by factors such as numeracy (Peters et al., 2006; Reyna et al., 2009) and graph literacy (Galesic and Garcia-Retamero, 2011). In a climate risk management context, this means not only that general communications about the phenomenon of climate change may be misunderstood, but that warnings about the immediate level of threat posed by specific impacts may not be understood and appropriately acted upon. Indeed, UK focus-groups conducted to examine perceptions of surface flood warnings, found that both members of the public and professional emergency respondents often failed to accurately interpret information about flood probabilities (Parker et al., 2011). Using verbal rather than numerical descriptions (e.g. terms such as “likely” or “unlikely”) may be one way of communicating uncertainty about future climate change impacts to non-technical individuals. However, while this strategy has been used in IPCC assessment reports (Mastrandrea et al., 2010), research conducted with members of the public in the UK and elsewhere suggests that the interpretation of such terminology may lead inconsistent perceptions of risk (Budesu et al., 2009; Harris and Corner, 2011). A number of resources make recommendations as to how information about risk and uncertainty can be most effectively presented (see for example Lipkus, 2007; Spiegelhalter et al., 2011). Although a full discussion of these is beyond the scope of the present review, we echo the point made by Spiegelhalter et al. (2011) that it is important to fully test how communications regarding risk will be interpreted before disseminating them.

## Synthesis and future directions

The preceding review discusses what is known about public perceptions of climate change risk and adaptation in a UK context. We find that, as is the case in other parts of the world, UK residents’ mental models of climate change often diverge

from those of experts: with climate change being conflated with other environmental problems (Fischer et al., 2012; Lorenzoni et al., 2006; Whitmarsh, 2009). However, when it comes to perceptions of climate change impacts, the available evidence suggests that those in the UK more readily associate climate change with different events (e.g. flooding and rainfall) than countries with warmer climates (Lorenzoni et al., 2006; Whitmarsh, 2009). Indeed, highlighting the possibility of an increase in warmer weather may elicit positive as well as negative responses amongst the British public (Palutikof et al., 2004). This underscores the importance of taking a country-specific approach to examining the link between perceptions of local weather and beliefs about climate change. It may also suggest that emphasising climate impacts relating to these locally salient wet-weather events could reduce psychological distancing and increase concern about climate change and its impacts. However, this possibility requires further investigation. Indeed, even if it proves to be effective, it could bring with it the unintended consequence of minimising the risk posed by increases in other climate risks such as heat waves.

With respect to willingness to undertake protective measures at an individual level, the available UK evidence suggests that prior experience of flooding does not consistently correspond with increased uptake of adaptive measures (Harries, 2012; Lamond et al., 2009). Whether this is the case for other anticipated climate change impacts, such as heat waves and water-shortages, however remains a largely open question. Once again, it may be the case that the positive association many members of the British public have with warmer weather, attenuates concern regarding the threats posed by an increase in hot, dry weather. Evidence gathered in the UK and elsewhere also suggests that, where climate change impacts represent an intensification of familiar forms of extreme weather, belief in climate change may not always be a prerequisite for supporting adaptation policy and taking protective action (Dessai and Sims, 2010; Stanford Woods Institute for the Environment, 2013). However, where anticipated climate change impacts represent “new” and psychologically distant hazards occurring in the future, climate change beliefs may be a stronger driver of support for adaptation policy and willingness to adopt protective measures (Buys et al., 2012; Alexander et al., 2012); which may further be compounded by uncertainty as to the magnitude of impacts (Few et al., 2007; Spence et al., 2012). Again, more research is needed to ascertain the extent to which climate change beliefs predict support for adaptation when it comes to familiar and unfamiliar impacts. Likewise, there is scope for further exploration of the extent to which attribution of responsibility and perceived personal agency affect both support for adaptation policy at a governmental level, and uptake of individual protection.

The question of how political affiliation and other personal values might impact on acceptance of adaptation policy also warrants further investigation. As discussed in ‘Uncertainty’, a clear correspondence between centre-right political affiliation and greater climate scepticism has been found in the UK (Poortinga et al., 2011; Whitmarsh, 2011) and other developed countries (McCright and Dunlap, 2011, 2013; Reser et al., 2012; Zia and Todd, 2010). However, the relationship between political affiliation and attitude towards adaptation measures and policy is far less clear. The little UK research that has examined the relationship between values related to governance and support for adaptation policy suggests that different governance-related values may predict support for different types of policy (Glenk and Fischer, 2010). As these findings come from a single study however, its generalizability may be limited.

From a climate change risk communication perspective, the UK research reviewed here has yielded findings that are generally consistent with those reported in the wider risk communication literature. Where fear-provoking climate change scenarios are presented without clear steps for mitigation and risk reduction, fatalism, helplessness and psychological distancing can be elicited (Bellamy and Hulme, 2011; Lowe et al., 2006). Likewise, work with flood victims suggests that anxiety and worry do not necessarily predict greater uptake of protective behaviours (Bradford et al., 2012; Harries, 2012). Indeed anxiety may elicit avoidant thinking and behaviours (Harries, 2012). This mirrors existing research conducted in the health promotion field, which suggests that fear-appeals are only effective if they induce only a moderate amount of fear, and provide recipients with risk reduction steps that can be readily implemented (Witte and Allen, 2000). As previously noted though, the predominance of flood-related research in the UK adaptation literature means that behavioural and psychological responses to other anticipated climate change impacts, especially those that represent “new” and unfamiliar hazards, is much less well understood.

As stated at the outset, this review was undertaken with the goal of ascertaining what is currently known about public perceptions of climate change risk and climate change adaptation amongst the UK public. We found relatively few studies about public perceptions of climate change adaptation. However, those focusing on public perceptions of climate change risks reveal several similarities between the climate change beliefs of those in the UK and other developed countries. There are however also key differences; with some of the most striking being related to the types of climate change impact most salient to UK residents versus those in countries with warmer and less temperate climates. This highlights the importance of taking a country-specific approach to examining and addressing public perceptions of the risks posed by climate change, as well as to promoting climate change adaptation.

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## Appendix A. Search terms

Climat\* risk OR Climat\* extreme OR Weather risk OR Weather extreme OR Flood\* OR Drought\* OR Heatwave\* OR Climate change adaptation

AND

“Risk perception\*” OR “Risk communication” OR “Risk management”

The search was filtered by country (i.e. restricted to England, Scotland, Northern Ireland and Wales). Search syntax is detailed below.

TOPIC: (Climat\* risk or Climat\* extreme or Weather risk or Weather extreme or Flood\* or drought\* or heat wave\* or “climate change adaptation”) AND TOPIC: (“Risk perception\*” OR “risk management” OR “risk communication”)

Refined by: COUNTRIES/TERRITORIES: (ENGLAND OR SCOTLAND OR NORTH IRELAND OR WALES)

Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH Timespan = 1900–2012

## Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.crm.2014.09.001>.

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